

CLAIMS

2. A security document comprising a substrate including at least one layer of polymeric material and containing an upconverting fluorescent material, and at least one coating containing a refractive pigment applied to the substrate, wherein
5 when the security document is exposed to electromagnetic radiation of a particular wavelength the upconverting material emits a signal of electromagnetic radiation of a shorter wavelength and the coating containing the refractive pigment enhances the signal emitted by the upconverting material.
3. A security document as claimed in claim 1 wherein the substrate includes
10 a polymeric base layer.
4. A security document as claimed in claim 2 wherein the base layer is formed from a transparent polymeric material.
5. A security document as claimed in claim 1 wherein the substrate includes a base layer of paper or fibrous material.
- 15 6. A security document as claimed in any one of claims 2 to 4 wherein the substrate includes one or more layers of polymeric material provided on a base layer.
7. A security document as claimed in any one of claims 2 to 5 wherein the upconverting material is dispersed in the base layer.
- 20 8. A security document as claimed in claim 5 wherein the upconverting material is dispersed in the at least one layer of polymeric material provided on the base layer.
9. A security document as claimed in any one of the preceding claims wherein the coating containing the refractive pigment is in intimate contact with
25 the at least one polymeric layer containing the upconverting material.

10. A security document as claimed in any one of the preceding claims wherein the coating containing the refractive pigment is a highly refractive opacifying coating.
11. A security document as claimed in claim 9 wherein the opacifying coating
5 comprises at least one refractive pigment dispersed in a polymeric or resin binder.
12. A security document as claimed in claim 10 wherein the at least one refractive pigment is selected from the group including titanium dioxide, calcium carbonate, barium sulphate and zinc oxide.
- 10 13. A security document as claimed in claim 11 wherein the binder is a cross-linked polymeric material.
14. A security document as claimed in claim 11 or claim 12 wherein the binder is selected from the group including acrylics, polyester and polyurethane.
15. A security document as claimed in any one of claims 11 to 13 wherein the
15 refractive pigment and the binder are substantially transparent to the excitation wavelengths used to excite the upconverting material.
16. A security document as claimed in claim 14 wherein the refractive index of the pigment is larger than the refractive index of the substrate.
17. A security document as claimed in claim 14 or claim 15 wherein the
20 refractive index of the pigment is larger than the refractive index of the binder.
18. A security document as claimed in claim 15 or claim 16, wherein the refractive index of the pigment is at least 0.3 greater than the refractive index of either the substrate or the binder.
19. A security document as claimed in any one of the preceding claims
25 wherein the substrate containing the upconverting fluorescent material is a

transparent substrate and the coating containing the refractive pigment is an opacifying coating which is applied only partly over the transparent substrate to form a window on at least one side of the security document which is not covered by the opacifying coating.

5 20. A security document as claimed in claim 18 wherein the opacifying coating is applied only partly on one side of the substrate, and the opacifying coating is applied to cover the entire surface of the polymeric layer on the opposite side of the substrate.

10 21. A security document as claimed in claim 18 or claim 19 wherein the signal emitted from parts of the substrate covered by the opacifying coating is stronger than the signal emitted from parts of the substrate which are uncovered by the opacifying coating.

15 22. A security document as claimed in any one of the preceding claims wherein the upconverting material is uniformly dispersed in the polymeric material.

23. A security document as claimed in any one of the preceding claims wherein the concentration of upconverting material is not more than about 1% by weight of the polymeric material.

20 24. A security document as claimed in claim 22 wherein the concentration of upconverting material is substantially within the range from about 0.0025% to about 0.25% by weight of the polymeric material.

25 25. A method of manufacturing a security document including : providing a substrate having at least one layer of polymeric material; incorporating at least one upconverting fluorescent material in the at least one layer of polymeric material; and applying a refractive coating to at least one surface of the substrate.

26. A method as claimed in claim 24 wherein the upconverting material is incorporated into the at least one layer of polymeric material in an extrusion process.

27. A method as claimed in claim 25 wherein in the extrusion process, the upconverting material is mixed uniformly with the co-extruded polymeric material as it passes through the extruder and dies.

28. A method as claimed in claim 26 wherein the upconverting material is mixed with the polymeric material, in an extruder barrel, at an elevated temperature.

29. A method as claimed in any one of claims 24 to 27 wherein the concentration of the upconverting material is not more than about 1% by weight of the polymeric material.

30. A method as claimed in claim 28 wherein the concentration of upconverting material falls substantially within the range from about 0.0025% to about 0.25% by weight of the polymeric material.

31. A method as claimed in any one of claims 24 to 29 wherein the refractive coating contains at least one refractive pigment which enhances signals emitted from the fluorescent upconverting material when the security document is exposed to electromagnetic radiation of a particular wavelength.

32. A method as claimed in claim 30 wherein the at least one refractive pigment is dispersed in a polymeric or resin binder.

33. A method as claimed in claim 30 or claim 31 wherein the at least one refractive pigment is selected from the group including titanium dioxide, calcium carbonate, barium sulphate and zinc oxide.

34. A method of verifying the authenticity of a security document including:
providing a substrate including at least one polymeric layer containing an
upconverting fluorescent material;
providing the substrate with at least one opacifying coating containing a
5 refractive pigment;
exposing the upconverting material to electromagnetic radiation of a
selected wavelength to excite the upconverting material; and
detecting a signal of electromagnetic radiation emitted from the excited
upconverting material at a shorter wavelength than the wavelength selected to
10 excite the upconverting material.
35. A method as claimed in claim 33 wherein the electromagnetic radiation
selected to excite the upconverting material is infra red radiation, and the signal of
electromagnetic radiation emitted from the upconverting material falls within the
visible spectrum.
- 15 36. A method as claimed in claim 33 or claim 34 wherein the at least one
opacifying coating only partly covers the substrate, and different signals emitted
from the covered and uncovered parts of the substrate are analysed to
authenticate the security document.